FORM PTO-1380 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	ATTORNEY'S DOCKET NUMBER: P120US00
	U.S. APPLN. NO. (If known, see 37 CFR 1.5) ☐ 9 7 8 8 9 8 5 1

INTERNATIONAL APPLICATION NO.: PCT/SE00/00135	INTERNATIONAL FILING DATE: 21 JANUARY 2000	PRIORITY DATE CLAIMED: 21 JANUARY 1999

TITLE OF INVENTION: X-RAY PIXEL DETECTOR DEVICE AND FABRICATION METHOD

APPLICANT(S) FOR DO/EO/US: Sture PETERSSON, Jan LINNROS, Christer FRÖJDH

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.

3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).

[X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

[X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))

   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau).

   b. [ ] has been transmitted by the International Bureau. (see attached copy of PCT/IB/308)

   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).

[ ] A translation of the International Application into English (35 U.S.C. 371(c)(2)).

[ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).

   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).

   b. [ ] have been transmitted by the International Bureau.

   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.

   d. [ ] have not been made and will not be made.

8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. [ ] A translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Item 11. to 16. below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. [X] A **FIRST** preliminary amendment.

   [ ] A **SECOND** or **SUBSEQUENT** preliminary amendment.

14. [ ] A substitute specification.

15. [ ] A change of power of attorney and/or address letter.

16. [X] Other items or information:

               International Search Report
               PCT/IB/304
               PCT/IPEA/409
               Abstract of the Disclosure on a Separate Sheet
               Application Data Sheet

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/889851	INTERNATIONAL APPLICATION NO. PCT/SE00/00135	ATTORNEY'S DOCKET NO. P120US00

		CALCULATIONS PTO USE ONLY

17. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee
(37 CFR1.445(a)(2)) paid to USTPO and International Search Report not prepared by
the EPO or JPO . . . . $ 1,000.00

International preliminary examination fee (37 CFR 1.482) not paid to USTPO but Interna-
tional Search Report prepared by the EPO or JPO . . . . $ 860.00

International preliminary examination fee (37 CFR 1.445(a)(2)) paid to USPTO . . . . $ 710.00

~~International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims~~
did not satisfy provisions of PCT Article 33(1)-(4) . . . . $ 690.00

International preliminary examination fee (37 CFR 1.482) paid to USTPO and all claims
satisfied provisions of PCT Article 33(1)-(4) . . . . $ 100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =		$	1,000.00
Surcharge of $130 for furnishing the oath or declaration later than 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		$	130.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	8 - 20 =	0	X $18.00	$	
Independent claims	2 - 3 =	0	X $80.00	$	
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)			+ $270.00	$	

TOTAL OF ABOVE CALCULATIONS =		$	1,130.00
Reduction of ½ for filing by small entity, if applicable. Applicant claims Small Entity Status under 37 CFR 1.27. +		$	565.00
SUBTOTAL =		$	565.00
Processing fee of $130 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR1.49(f)).		$	
TOTAL NATIONAL FEE =		$	565.00
Fee for recording the enclosed assignment (37 CFR1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +		$	
TOTAL FEES ENCLOSED =		$	565.00

Amount to be refunded:	
charged:	

a. [X] A check in the amount of $ **565.00** to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. **25-0120** in the amount of $ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required by 37 CFR 1.16 and 1.17, or credit any overpayment to Deposit Account No. **25-0120**. A duplicate copy of this sheet is enclosed.

SEND ALL CORRESPONDENCE TO:

Customer No. 000466
YOUNG & THOMPSON   July 23, 2001
745 South 23rd Street
2nd Floor
Arlington, VA 22202
(703) 521-2297 facsimile (703) 685-0573

By *Benoît Castel*

Benoît Castel
Attorney for Applicants
Registration No. 35,041

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Sture PETERSSON et al.

Serial No. (unknown)

Filed herewith

X-RAY PIXEL DETECTOR DEVICE
AND FABRICATION METHOD

PRELIMINARY AMENDMENT

Commissioner for Patents

      Washington, D.C. 20231

Sir:

      Prior to calculation of the filing fee, please amend the above-identified application as follows:

IN THE CLAIMS:

      Amend claim 4 as follows:

      --4. (Amended) The method according to claim 1, characterized by the further step of producing a pore spacing being less than the image detector pixel size (2) to provide a structure without the need for alignment to the image detector chip (1).--

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R E M A R K S

The above change in the claim merely place this national phase application in the same condition as it was during the international phase, with the multiple dependencies being removed.

Attached hereto is a marked-up version of the changes made to the claim by the current amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE".

Respectfully submitted,

YOUNG & THOMPSON

By _____

Benoît Castel
Attorney for Applicants
Registration No. 35,041
Customer No. 00466
745 South 23rd Street
Arlington, VA 22202
Telephone: 703/521-2297

July 23, 2001

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

The claim has been amended as follows:

4. (Amended) The method according to ~~any of the preceding~~ claims **1**, characterized by the further step of producing a pore spacing being less than the image detector pixel size (2) to provide a structure without the need for alignment to the image detector chip (1).

ABSTRACT OF THE DISCLOSURE

A method and device for producing an X-ray pixel detector, for X-ray photons, the detector presenting high efficiency combined with high resolution for obtaining a high image quality detector while at the same time minimizing the X-ray dose used. The application is particularly important whenever the X-ray photon absorption distance is much longer than the required pixel size. The arrangement presents a structure based on light-guiding of secondarily produced photons within a scintillating pixel detector in conjuction with, a CCD or a CMOS pixel detector. The structure presents a matrix (8) having deep pores (10) fabricated by high-aspect ratio silicon etching techniques producing very thin walls and with a pore spacing less or equal to the size of a pixel (2) of the image detector used. The pore matrix is subsequently filled by melting a scintillating material into the pores such that, in each pore, a single scintillating block is formed. The silicon matrix (8) may further utilize a reflective layer to increase light guiding down to the image detector chip.

X-ray pixel detector device and fabrication method

TECHNICAL FIELD

The present invention relates to an X-ray pixel detector, and more exactly to
a pixel-camera based imaging detector for X-ray photons with high efficiency
combined with high resolution.

BACKGROUND

Silicon devices as CCDs and CMOS pixel detectors are frequently used for X-
ray imaging. Due to the low stopping for X-rays in silicon, the detector is
generally coated with a scintillating layer. When using scintillating layers for
imaging there is a trade-off between quantum efficiency and resolution. In
order to get high quantum efficiency for X-rays the layer should be made
thick, but that will reduce the spatial resolution in the image. The quantum
efficiency for X-rays is one of the most critical parameters for medical X-ray
imaging devices since the signal to noise ratio in the image depends on the
number of X-ray photons contributing to the image. Since photoelectric
absorption is a single event an X-ray photon will either be fully absorbed or
pass unnoticed through the detector.

X-ray generators for dental X-ray imaging operate with an accelerating
voltage of 60 – 90 kV giving mean photon energy in the range 30 – 40 keV.
The material thickness required to stop 80 % of the X-ray photons is in the
range 150 – 500 μm for the commonly used scintillators. The primary
interaction between the photon and the material, photoelectric absorption, is
a single event. The light in the scintillator is then generated by a large
number of secondary reactions taking place within a few microns from the
location of the primary interaction. As a result a flash of light is generated
close to the spot of the primary interaction and radiated in all directions. The
quantum efficiency for X-rays is then related to the probability for the
primary interaction to occur and to a very small extent to the secondary
interactions. In the energy range of interest for such an application and with
the materials used as scintillators the primary interaction is generally a

photoelectric absorption. Compton scattering and other events are less likely to occur.

The light generated in the scintillator is projected onto the sensor with a spot size, which is proportional to the distance between the point of interaction and the position of absorption in the sensor. The projection is also affected by the refractive indexes of the materials the beam will pass. For a typical combination of scintillator and CCD, the scintillator thickness should be less than 100 μm to achieve a spatial resolution > 10 line-pairs/mm, as required for dental X-ray imaging.

A method to improve the spatial resolution of thick scintillating layers is to define pixels in the scintillator, as proposed in EP-A2-0 534 683, US-A-5,059,800 and US-A-5,831,269 and to make sure that the light generated within one pixel is confined within that pixel. Pixel definition in scintillators can be done in a number of ways, e.g. columnar growth of scintillator crystals or groove etching in scintillating films. In EP-A2-0 534 683 dicing or cutting is suggested for separating scintillator elements from a large scintillator block, as appropriate for larger lateral dimensions.

The method for columnar growth of scintillating crystals is well known. It has been used to grow CsI for many years. The document WO93/03496 discloses for instance growth of separate columns in different scintillators whereas in US-A-4 663 187 a scintillator is held close to the melting point resulting in the formation of domains. The disadvantage of techniques for growth of separated columns is that the columns tend to grow together for thick layers and that light will leak to adjacent columns. It is difficult to apply a light reflector between the columns.

Etching of grooves in scintillating materials is considered to be extremely difficult due to the high aspect ratios required by the application. With a pixel size of 50 μm and an allowed area loss of less than 20 % the groove width should be less than 5 μm. If the film thickness is 200 μm the aspect

ratio will be 40. This aspect ratio can only be realised by advanced silicon processing techniques whereas etching techniques for scintillating materials are far less developed. Nevertheless, US-A-5,519,227 claims that laser-based micro-machining techniques could be used to define narrow grooves in a scintillating substrate. However, the technique is inherently slow as the laser needs to be scanned several times in every groove. Furthermore, it is not clear whether re-deposition onto the walls will occur as a result of this laser ablation, which could potentially block a narrow groove.

Summarising, various techniques have been proposed for the fabrication of a scintillator array that would provide light guiding of secondary photons to an underlying imaging detector. These techniques are all restricted in one or several aspects: either too large lateral dimensions (cutting, dicing), problems of forming a well-defined narrow wall (laser ablation), cross talk between adjacent pixels (columnar growth technique) or a lengthy processing time (valid for most of these techniques). Finally, deposition of a reflective layer in the grooves is usually suggested to improve light guiding and reduce cross talk. But, none of these fabrication schemes have proposed a detailed scheme how the reflective layer would be produced. This is not an easy task considering the narrow pore geometry and materials involved.

Therefore there is still a desire to develop a device and it's associated fabrication method, which should be able to handle thick scintillating material layers but with a maintained resolution which corresponds to the individual pixel size. Furthermore, the fabrication technique should preferably be fast, as for a mass scale production type, and relying as much as possible on existing processes and machinery.

SUMMARY

The objective of the present invention is to design and develop a fabrication method for an X-ray pixel detector, i.e. an imaging detector for X-ray photons presenting high efficiency combined with high resolution to obtain a high image quality detector while at the same time minimizing the X-ray dose

used. The application is particularly important whenever the X-ray photon absorption distance is much longer than the required pixel size.

It is proposed to take advantage of the mature processing tools of the silicon microelectronics technology where lateral dimensions on a micrometer scale may readily be achieved. Thus, a silicon mold is fabricated by high-aspect ratio etching of a silicon substrate for form an array of pores. This array is subsequently oxidized to provide a low refractive index layer in contact with each individual scintillator block, formed by melting a scintillating material into the pores.

A scintillator device according to the present invention presents a structure based on light guiding of secondarily produced scintillating photons in a pixel detector in conjunction with, for instance, a CCD or a CMOS pixel detector. The structure according to the invention presents a matrix having deep pores created by thin walls presenting a pore spacing appropriate to the image detector in use, and may utilize a reflective layer on the walls of the matrix to increase light guiding down to the image detector chip.

The method according to the present invention is set forth by the attached independent claim 1 and further embodiments are defined by the dependent claims 2 to 4. A scintillator device is set forth by the independent claim 5 and further embodiments are defined by the dependent claims 6 to 8.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with further objects and advantages thereof, may best be understood by making reference to the following description taken together with the accompanying drawings, in which:

FIG. 1   illustrates a silicon CCD pixel detector for direct irradiation by X-rays;

FIG. 2   illustrates a pixel detector as of FIG. 1 but provided with a thin
          scintillator for increasing its efficiency for X-ray radiation;

FIG. 3   illustrates a pixel detector as of FIG. 1 provided with a thick
          scintillator for further increasing the efficiency for X-ray radiation,
          but then loosing resolution;

FIG. 4   illustrates a CCD pixel detector using a thick pixel scintillator
          residing inside pores formed in a matrix material according to the
          present invention for maximum sensitivity and maintained
          resolution;

FIG. 5   is a more detailed view of the structure forming pores for
          increasing the efficiency of a CCD pixel detector; and

FIG. 6   is an enlargement of a portion of a pore indicating an extra layer of
          silicon oxide for improving the wall reflecting properties.

                          DETAILED DESCRIPTION

General features

The most developed etching techniques exist for silicon processing.
According to the present application a grid is created by etching rectangular
holes in a silicon wafer. The holes can be etched to a certain depth or go all
the way through the wafer. The holes are then filled with scintillating
material.

The performance of such a device strongly depends on how well the holes are
filled, the transparency of the scintillator and the reflection properties of the
walls of the hole.

The present X-ray pixel detector concept is for clarity compared to existing
technology demonstrated in Figures 1 to 4. FIG. 1: A standard silicon CCD

arrangement has a very low efficiency for X-ray photon detection, normally of the order of a few per cent. This is because the penetration depth of X-ray photons, at energies of the order 40 keV, is of the order of 1 cm in silicon and thus the fraction absorbed within the active CCD layer is small.

The efficiency will preferably be increased significantly by using a scintillating material emitting a large number of visible photons for every absorbed X-ray photon as is indicated in FIG. 2. Typical absorption lengths for X-ray photons, at energies of the order 40 keV, are several 100 µm. As already mentioned a layer of the order 300 µm of CsI is needed to absorb about 80 % of the X-ray photons. Thus, for thick scintillating films as indicated in FIG. 3, almost all X-ray quanta may be absorbed, which results in a high efficiency detector. However, the trade-off is resolution, which becomes much worse as the scintillator emits photons isotropically, such that nearby pixels will also detect a significant number of photons. An alternative route is to use a thin scintillating film (of about same thickness as a pixel size) as indicated in FIG. 2, but at the expense of a much lower efficiency.

Finally, in FIG. 4 is shown the concept of the invention resulting in both high efficiency and high resolution. Here, a thick scintillator is used which has been patterned into pixels corresponding to the size of the pixels of the image detector, e.g. a CCD, in such a way that the scintillator pixels also serve as light guides which confine the emitted photons to the same pixel element only. Thus, no cross talk between pixels takes place and, depending on the pixel thickness (length perpendicular to the CCD surface) up to 100 % of the incoming X-ray photons may be absorbed. However, in order to achieve a large effective detection area the spacing between pixels must be short, e.g. for a typical 44 µm pixel size a 4 µm gap between pixels results in ~82 % efficiency due to the 'dead area' in between pixels. Clearly, to minimize cross-talk pixels may be reflection coated or the medium in between should be highly absorbing.

The fabrication of pixels having a thickness of 300 μm and a gap of about 4 μm from a scintillating material is not an easy task. The present invention therefore benefits from the mature silicon process technology using a silicon matrix wherein corresponding pores have been fabricated and successively filled with a scintillator material. The fabrication technology involves more or less standard silicon fabrication technologies such as Deep Reactive Ion Etching (DRIE), oxidation and/or metallisation. A schematic drawing of the structure is shown in FIG. 5 where 3 pixels are displayed together with a close-up of the wall structure between adjacent pixels being demonstrated in FIG. 6. In essence, the structure contains three different materials to provide the light-guiding effect the processing of which is accomplished one after the other:

Silicon pore matrix

The silicon pore matrix of the present application may be fabricated using two different techniques: Deep Reactive Ion Etching (DRIE) or Electrochemical etching. DRIE is now an established technique and several hundred μm deep pores may be fabricated. It has been found that it is possible to make, for instance, 40 x 40 μm square-formed pores with a wall thickness of 3 - 4 μm (representing ~80 % active area) and with a depth of a few hundred μm. A similar structure may be formed by electrochemical etching of silicon starting from pore initiation cones made by conventional lithography and non-isotropic etching.

Wall reflection layer

Scintillating materials usually have an index of refraction (for CsI $n = 1.79$) which is significantly lower than that of silicon ($n = 3.4$). Thus, the major fraction of scintillating photons impinging on the pore walls will penetrate into the silicon (Si) matrix unless some reflection coating of the pore walls has been provided. Therefore, this simple structure will have much lower efficiency since no light guiding exists. In the silicon matrix the light will be quickly absorbed due to the high absorption coefficient for visible light in silicon. However, note that this is a clear advantage of the present invention,

as opposed to several of the structures cited in the Background paragraph, as it totally eliminates any cross talk between pixels.

To provide light guiding a reflecting layer must be introduced at the walls. This may be accomplished either by oxidation or by coating with a metal layer. Whereas silicon dioxide is much more stable during subsequent processing, metal coating provides better reflection. In the case of an oxide, a total reflection results whenever the entrance angle is larger than the result of the expression $\arcsin(n_2/n_1)$, where n_2 and n_1 represents a respective refractive index. The reflection results in a light-guiding cone propagating upwards and downwards in the pore, see FIG. 5. The difference to a metal-coated pore (where all light would be guided in the pore) is, however, not that large as light rays impinging on the walls close to normal incidence correspond to very long path lengths before reaching the image detector cell and thus absorption is more likely.

Finally, a reflecting layer at the bottom of the pore (or at the top surface for a pore structure, which is transparent) is highly desirable in order to redirect and collect photons emitted in the upward direction.

Filling with scintillating material

Filling of the pores with scintillating material is a crucial step. Extensive tests have proved that filling of the pores with scintillating powder without melting does not yield an operational device structure. This is because grain boundary scattering of the light results in a very short penetration distance. An index-matched fluid could possibly circumvent this problem but the low effective density of the scintillator powder (large unfilled fraction) would then demand very deep pores.

Due to this fact our invention involves melting of the scintillating material to form single or polycrystalline blocks of scintillator material within each pore. For this purpose we have used CsI as a suitable material as it does not decompose upon melting. The melting and filling should be carried out in a

vacuum to reduce problems with air bubbles in the pores, which significantly affects efficiency and the light guiding ability of the pores.

In summary, the present invention is based upon light guiding of secondarily produced scintillating photons in a pixel detector in conjunction with, for instance a CCD camera or a corresponding device. The three ingredients of the preferred embodiment of the structure are:

a)   A matrix with deep pores, thin walls and a pore spacing appropriate to the image detector chip in use

b)   A reflective layer on the walls to increase light guiding down to the image detector chip

c)   A suitable scintillating material which is melted into the pores to form a single scintillating block in order to eliminate grain-boundary scattering

In addition, the invention concerns a suitable fabrication method to realize this structure in an efficient way suitable for mass production.

It will be understood by those skilled in the art that various modifications and changes may be made to the present invention without departure from the scope thereof, which is defined by the appended claims.

CLAIMS

1.   A method for fabricating a structured high resolution scintillating device based on light guiding of secondary produced scintillating photons for use in an X-ray pixel detector device with an image detector chip (1), **characterized by** the steps of

fabrication of a silicon pore matrix (8) presenting a pore spacing (10) corresponding to the image detector pixel size (2), by utilizing silicon etching techniques such as deep reactive ion etching, electrochemical techniques or other techniques providing high-aspect ratios such that thin pore walls of thickness reaching down to a few micrometers will be maintained for an active detection area optimization;

using the silicon pore matrix (8) as a mold when melting a scintillator material into the pores to form in each pore a single scintillating block in order to eliminate grain-boundary scattering of scintillating photons.

2.   The method according to claim 1, **characterized by** the further step of providing, after etching but before molding, a reflection layer for light guiding by oxidation of the silicon pore matrix (8) or by deposition of any layer having a resulting refractive index being lower than that of the used scintillator material.

3.   The method according to claim 1, **characterized by** the further step of, after etching but before molding, depositing a metallic reflective layer in the pores.

4.   The method according to any of the preceding claims, **characterized by** the further step of producing a pore spacing being less than the image detector pixel size (2) to provide a structure without the need for alignment to the image detector chip (1).

5.   A scintillating device for simultaneously maintaining resolution and increased sensitivity for X-ray radiation in an imaging arrangement, **characterized by** utilization of a fabrication method producing a silicon pore matrix (8) presenting a pore spacing (10) corresponding to an image detector pixel size (2), the pore matrix having deep pores (10) presenting thin walls of a thickness reaching down to a few micrometers to create a pore spacing corresponding to the pixel size (2) of an image detector chip (1), the pore matrix (8) further containing scintillating material which is melted into the pores (10) to form in each pore a single scintillating block in order to eliminate grain-boundary scattering of scintillating photons.

6.   The device according to claim 5, **characterized by** a reflective layer (12) onto the thin walls of the matrix to increase light guiding down to the image detector chip (1).

7.   The device according to claim 5, **characterized in** a pore spacing being less than the image detector pixel size (2) to thereby provide a structure without need for alignment to the image detector chip (1).
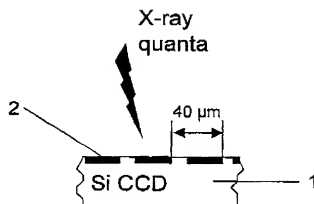
8.   The device according to claim 6, **characterized in** a pore spacing being less than the image detector pixel size (2) to thereby provide a structure without need for alignment to the image detector chip (1).
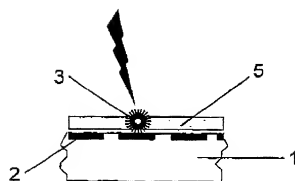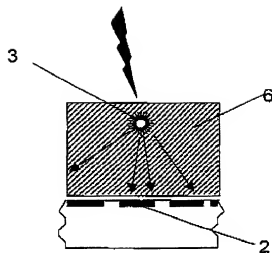
- - -

X-ray quanta

40 µm

Si CCD

Fig. 1

Fig. 2

Fig. 3
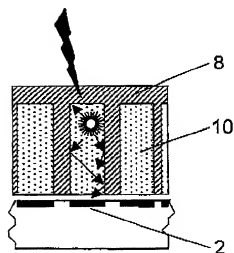

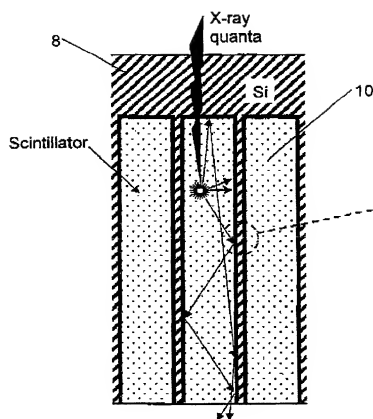
Fig. 4

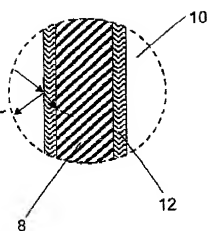Fig. 5   Fig. 6

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

     X-ray pixel detector device and fabrication method

the specification of which: *(check one)*

REGULAR OR DESIGN APPLICATION

[ ]   is attached hereto.

[ ]   was filed on _____ as application Serial No.
            _____ and was amended on _____
            (if applicable).   .

PCT FILED APPLICATION ENTERING NATIONAL STAGE

[X]   was described and claimed in International application No.
            PCT/SE00/00135 __ filed on _21 January 2000_
            and as amended on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

PRIORITY CLAIM

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)

Country	Application Number	Date of Filing (day, month, year)	Priority-Claimed
Sweden	9900181-0	21 January 1999	Yes

(Complete this part only if this is a continuing application.)

I hereby claim the benefit under 35 USC 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

_____

(Application Serial No.)   (Filing Date)   (Status—patented, pending, abandoned)

POWER OF ATTORNEY

The undersigned hereby authorizes the U.S. attorney or agent named herein to accept and follow instructions from Aros Patent AB as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorney or agent and the undersigned. In the event of a change in the persons from whom instructions may be taken, the U.S. attorney or agent named herein will be so notified by the undersigned.

As a named inventor, I hereby appoint the following attorney(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: **Robert J. PATCH, Reg. No. 17,355, Andrew J. PATCH, Reg. No. 32,925, Robert F. HARGEST, Reg. No. 25,590, Benoît CASTEL, Reg. No. 35,041, Eric JENSEN, Reg. No. 37,855, Thomas W. PERKINS, Reg. No. 33,027, and Roland E. LONG, Jr., Reg. No. 41,949,** c/o YOUNG & THOMPSON, Second Floor, 745 South 23rd Street, Arlington, Virginia 22202.

Address all telephone calls to Young & Thompson at 703/521-2297.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: Sture Petersson
   (given name, family name)

Inventor's signature _____   Date _Aug 28/01_

Residence: Uppsala, Sweden SEX   Citizenship: Swedish

Post Office Address:
       Sandmovägen 5B, SE-756 47 UPPSALA, Sweden

Full name of second joint inventor, if any: Jan Linnros
   (given name, family name)

Inventor's signature _____   Date _August 31, 2001_

Residence: Bromma, Sweden SEX   Citizenship: Swedish

Post Office Address:
       Ehrenstralsvägen 42, SE-168 51 BROMMA, Sweden

Full name of third joint inventor, if any: Christer Fröjdh
   (given name, family name)

Inventor's signature _____   Date _Aug 30, 01_

Residence: Sundsvall, Sweden SEX   Citizenship: Swedish

Post Office Address:
       Fänriksgatan 4A, SE-852 38 SUNDSVALL, Sweden